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Kurabayashi

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(54) **PROTECTION OF PRIVATE DATA**

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H04L 12/58 (2006.01)
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CPC ***H04L 63/0428*** (2013.01); ***G06F 17/3053*** (2013.01); ***H04L 51/046*** (2013.01)

(58) **Field of Classification Search**
CPC H04L 63/0428; H04L 29/06639; H04L 61/2539; H04L 2209/16
See application file for complete search history.

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(57) **ABSTRACT**

Technologies are generally described for generating obfuscated message data. In some examples, a method performed under control of a server may include calculating co-occurrence probabilities of a plurality of combinations, each of which includes at least two elements that are included in original message data; extracting, from the original message data, a first data set that includes at least one combination that has a first co-occurrence probability from among the plurality of combinations and a second data set that includes at least one combination that has a second co-occurrence probability from among the plurality of combinations; generating dummy data by using the first data set and the second data set; and adding the generated dummy data to the original message data to generate obfuscated message data.

18 Claims, 6 Drawing Sheets

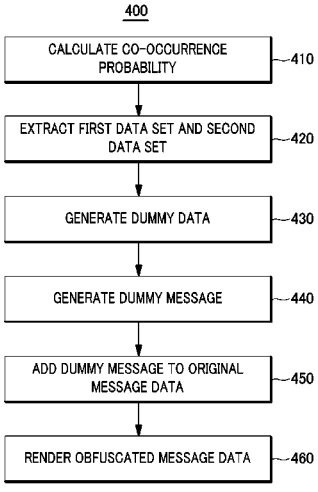

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FIG. 1

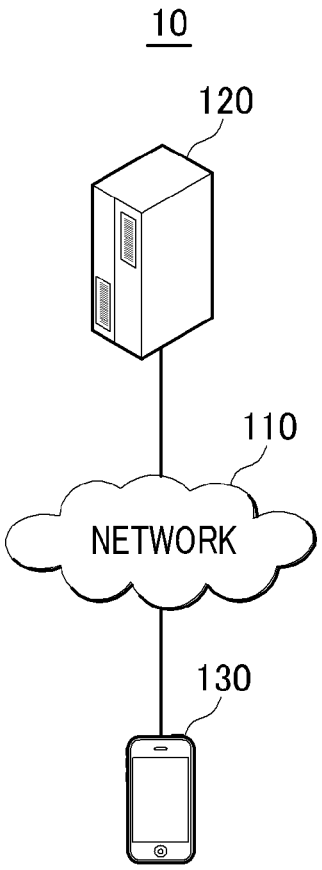


FIG. 2

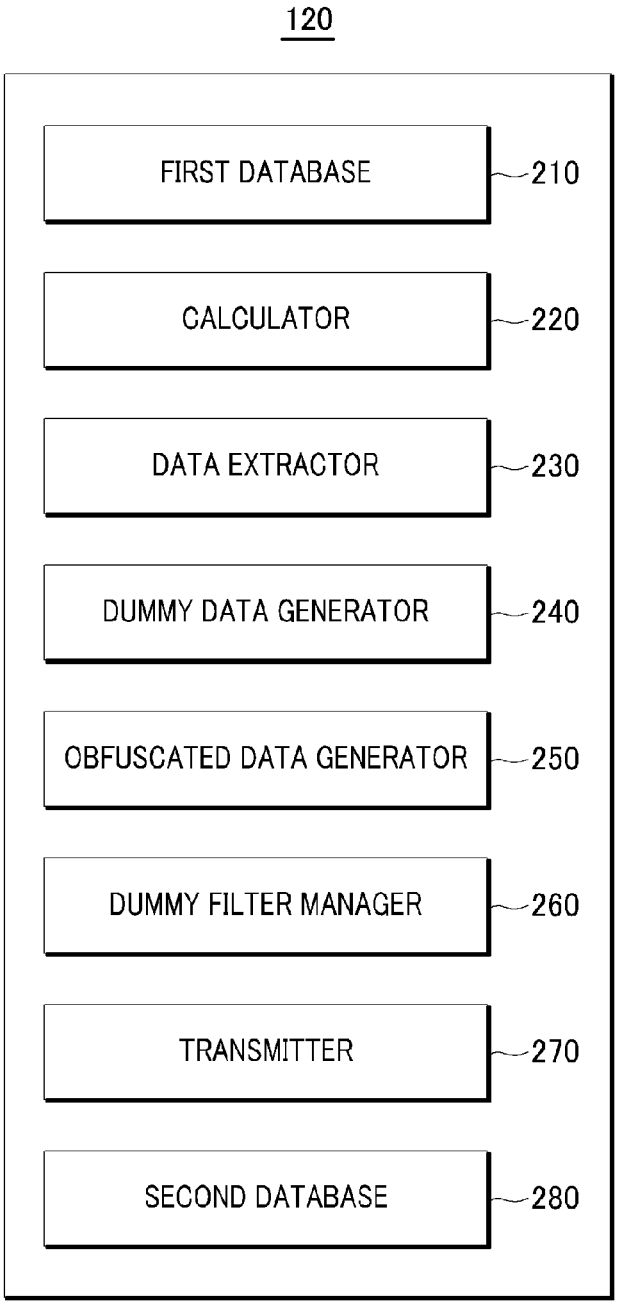

120
FIRST DATABASE
210
CALCULATOR
220
DATA EXTRACTOR
230
DUMMY DATA GENERATOR
240
OBFUSCATED DATA GENERATOR
250
DUMMY FILTER MANAGER
260
TRANSMITTER
270
SECOND DATABASE
280

FIG. 3

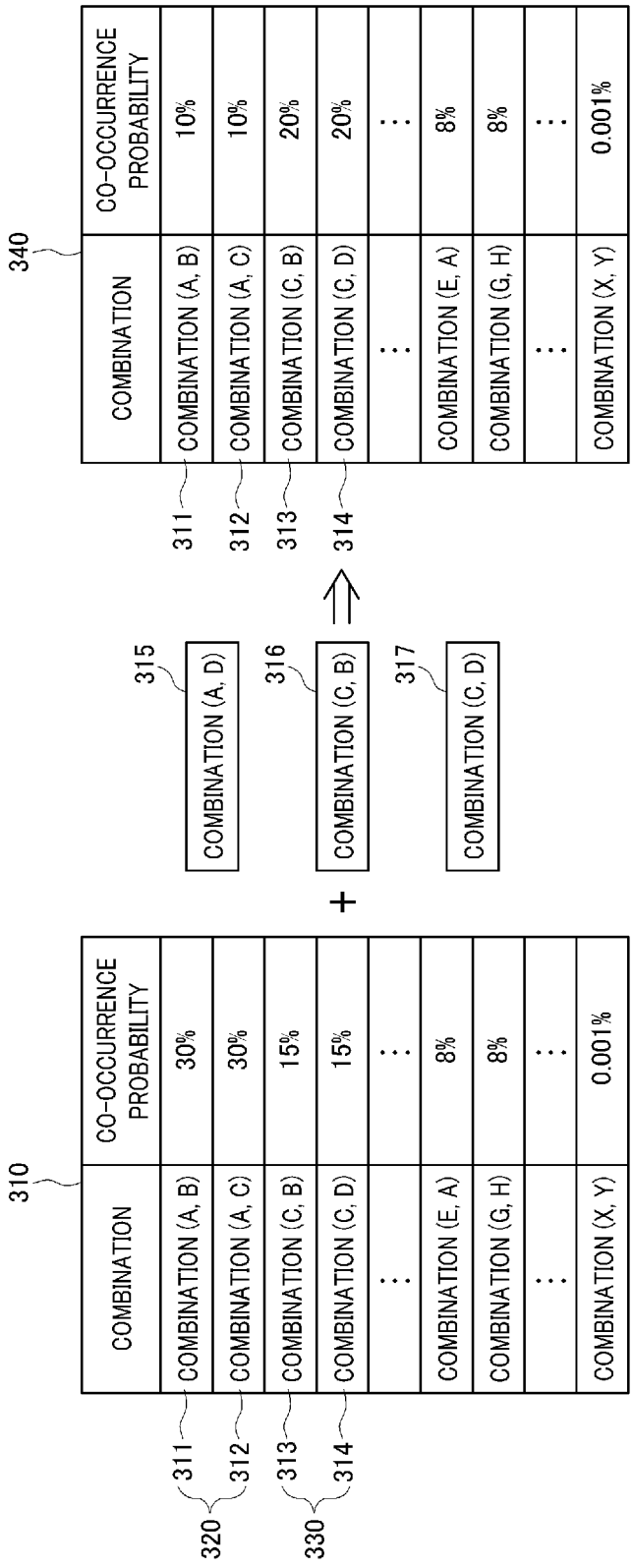

310
COMBINATION
CO-OCCURRENCE PROBABILITY
COMBINATION (A, B) 30%
COMBINATION (A, C) 30%
COMBINATION (C, B) 15%
COMBINATION (C, D) 15%
COMBINATION (E, A) 8%
COMBINATION (G, H) 8%
COMBINATION (X, Y) 0.001%
311
312
313
314
320
330
315
COMBINATION (A, D)
316
COMBINATION (C, B)
317
COMBINATION (C, D)
340
COMBINATION
CO-OCCURRENCE PROBABILITY
COMBINATION (A, B) 10%
COMBINATION (A, C) 10%
COMBINATION (C, B) 20%
COMBINATION (C, D) 20%
COMBINATION (E, A) 8%
COMBINATION (G, H) 8%
COMBINATION (X, Y) 0.001%

FIG. 4

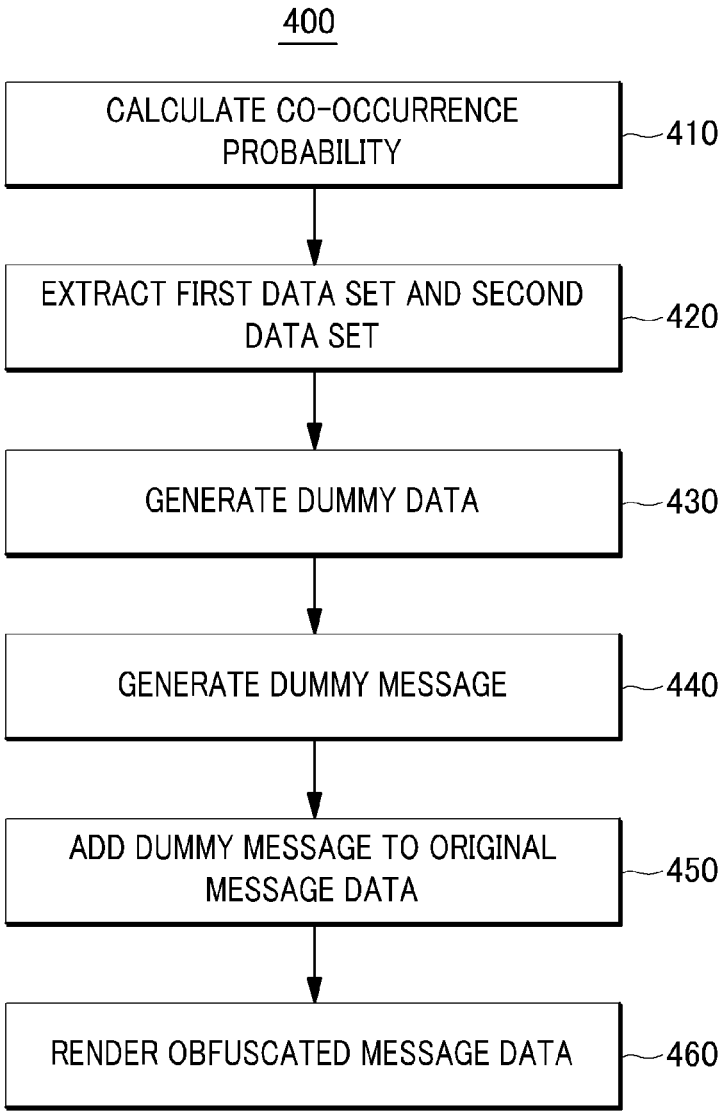

400
CALCULATE CO-OCCURRENCE PROBABILITY
410
EXTRACT FIRST DATA SET AND SECOND DATA SET
420
GENERATE DUMMY DATA
430
GENERATE DUMMY MESSAGE
440
ADD DUMMY MESSAGE TO ORIGINAL MESSAGE DATA
450
RENDER OBFUSCATED MESSAGE DATA
460

FIG. 5

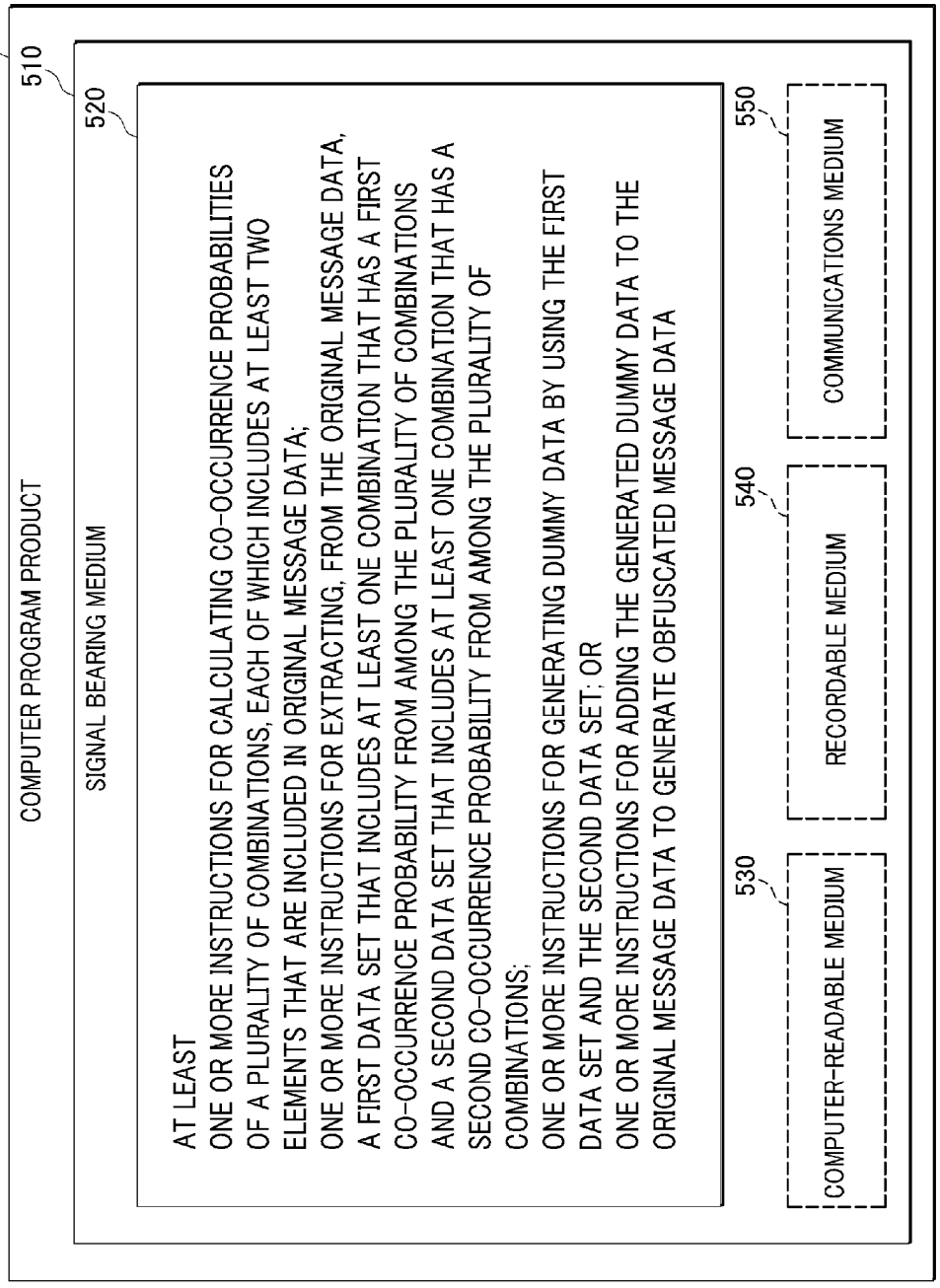
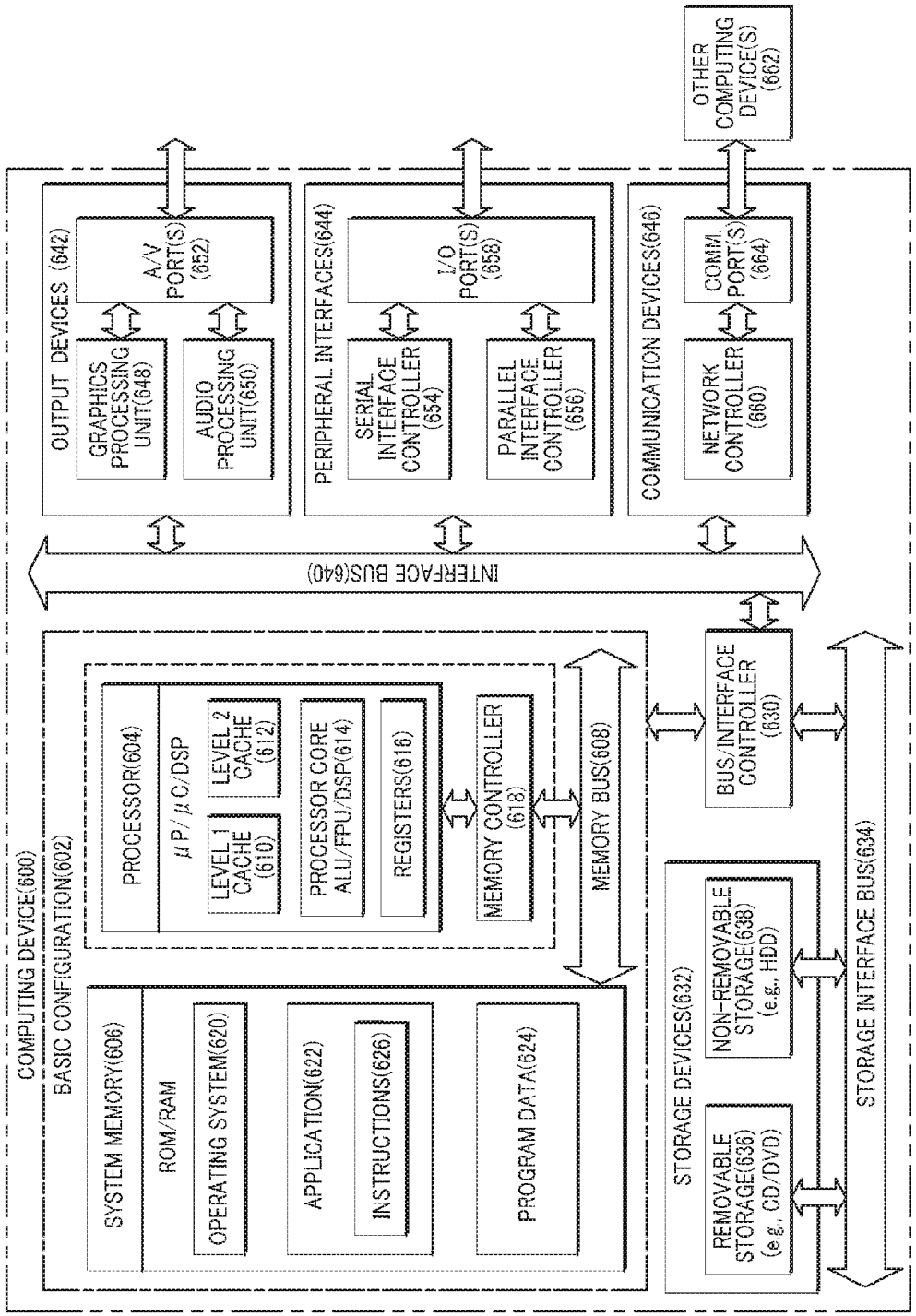

500
COMPUTER PROGRAM PRODUCT
510
SIGNAL BEARING MEDIUM
520
AT LEAST
ONE OR MORE INSTRUCTIONS FOR CALCULATING CO-OCCURRENCE PROBABILITIES OF A PLURALITY OF COMBINATIONS, EACH OF WHICH INCLUDES AT LEAST TWO ELEMENTS THAT ARE INCLUDED IN ORIGINAL MESSAGE DATA;
ONE OR MORE INSTRUCTIONS FOR EXTRACTING, FROM THE ORIGINAL MESSAGE DATA, A FIRST DATA SET THAT INCLUDES AT LEAST ONE COMBINATION THAT HAS A FIRST CO-OCCURRENCE PROBABILITY FROM AMONG THE PLURALITY OF COMBINATIONS AND A SECOND DATA SET THAT INCLUDES AT LEAST ONE COMBINATION THAT HAS A SECOND CO-OCCURRENCE PROBABILITY FROM AMONG THE PLURALITY OF COMBINATIONS;
ONE OR MORE INSTRUCTIONS FOR GENERATING DUMMY DATA BY USING THE FIRST DATA SET AND THE SECOND DATA SET; OR
ONE OR MORE INSTRUCTIONS FOR ADDING THE GENERATED DUMMY DATA TO THE ORIGINAL MESSAGE DATA TO GENERATE OBFUSCATED MESSAGE DATA
530
COMPUTER-READABLE MEDIUM
540
RECORDABLE MEDIUM
550
COMMUNICATIONS MEDIUM

FIG. 6


COMPUTING DEVICE(600)
BASIC CONFIGURATION(602)
PROCESSOR(604)
μP/μC/DSP
LEVEL 1 CACHE (610)
LEVEL 2 CACHE (612)
PROCESSOR CORE ALU/FPU/DSP(614)
REGISTERS(616)
MEMORY CONTROLLER (618)
SYSTEM MEMORY(606)
ROM/RAM
OPERATING SYSTEM(620)
APPLICATION(622)
INSTRUCTIONS(626)
PROGRAM DATA(624)
MEMORY BUS(608)
BUS/INTERFACE CONTROLLER (630)
INTERFACE BUS(640)
OUTPUT DEVICES (642)
GRAPHICS PROCESSING UNIT(648)
AUDIO PROCESSING UNIT(650)
A/V PORT(S) (652)
PERIPHERAL INTERFACES(644)
SERIAL INTERFACE CONTROLLER (654)
PARALLEL INTERFACE CONTROLLER (656)
I/O PORT(S) (658)
COMMUNICATION DEVICES(646)
NETWORK CONTROLLER (660)
COMM. PORT(S) (664)
OTHER COMPUTING DEVICE(S) (662)
STORAGE DEVICES(632)
REMOVABLE STORAGE(636) (e.g., CD/DVD)
NON-REMOVABLE STORAGE(638) (e.g., HDD)
STORAGE INTERFACE BUS(634)

PROTECTION OF PRIVATE DATA

BACKGROUND

Data mining has received a great deal of attention as a technique for extracting knowledge or information from a large scale data, e.g., a group of SNS messages or content. To protect implicit privacy data in the large scale database against the data mining, methods for uniformly prohibiting public accesses to the data or uniformly encrypting the data have been provided. However, these methods do not satisfy demands of users to share the SNS messages or content that they themselves have posted on their SNS pages.

SUMMARY

In an example, a method performed under control of a server may include calculating co-occurrence probabilities of a plurality of combinations, each of which includes at least two elements that are included in original message data; extracting, from the original message data, a first data set that includes at least one combination that has a first co-occurrence probability from among the plurality of combinations and a second data set that includes at least one combination that has a second co-occurrence probability from among the plurality of combinations; generating dummy data by using the first data set and the second data set; and adding the generated dummy data to the original message data to generate obfuscated message data.

In another example, a server may include a calculator configured to calculate co-occurrence probabilities of a plurality of combinations, each of which includes at least two elements that are included in original message data; a data extractor configured to extract, from the original message data, a first data set that includes at least one combination that has a first co-occurrence probability from among the plurality of combinations and a second data set that includes at least one combination that has a second co-occurrence probability from among the plurality of combinations; a dummy data generator configured to generate dummy data by using the first data set and the second data set; and an obfuscated data generator configured to add the generated dummy data to the original message data to generate obfuscated message data.

In yet another example, a computer-readable storage medium having stored thereon computer-executable instructions that, in response to execution, may cause a server to perform operations including: calculating co-occurrence probabilities of a plurality of combinations, each of which includes at least two elements that are included in original message data; extracting, from the original message data, a first data set that includes at least one combination that has a first co-occurrence probability from among the plurality of combinations and a second data set that includes at least one combination that has a second co-occurrence probability from among the plurality of combinations; generating dummy data by using the first data set and the second data set; and adding the generated dummy data to the original message data to generate obfuscated message data.

The foregoing summary is illustrative only and is not intended to be in any way limiting. In addition to the illustrative aspects, embodiments, and features described above, further aspects, embodiments, and features will become apparent by reference to the drawings and the following detailed description.

BRIEF DESCRIPTION OF THE FIGURES

The foregoing and other features of this disclosure will become more fully apparent from the following description and appended claims, taken in conjunction with the accompanying drawings. Understanding that these drawings depict only several embodiments in accordance with the disclosure and are, therefore, not to be considered limiting of its scope, the disclosure will be described with additional specificity and detail through use of the accompanying drawings, in which:

FIG. **1** schematically shows an illustrative example of an environment including a server and an end device, arranged in accordance with at least some embodiments described herein;

FIG. **2** shows a schematic block diagram illustrating an example architecture for a server, arranged in accordance with at least some embodiments described herein;

FIG. **3** schematically shows illustrative example original message data combinations and obfuscated message data combinations, arranged in accordance with at least some embodiments described herein;

FIG. **4** schematically shows an example flow diagram of a process of a server for generating obfuscated message data, arranged in accordance with at least some embodiments described herein;

FIG. **5** illustrates a computer program product that may be utilized to provide an obfuscated message data generating scheme, arranged in accordance with at least some embodiments described herein; and

FIG. **6** is a block diagram illustrating an example computing device that may be utilized to provide an obfuscated message data generating scheme, arranged in accordance with at least some embodiments described herein.

DETAILED DESCRIPTION

In the following detailed description, reference is made to the accompanying drawings, which form a part hereof. In the drawings, similar symbols typically identify similar components, unless context dictates otherwise. The illustrative embodiments described in the detailed description, drawings, and claims are not meant to be limiting. Other embodiments may be utilized, and other changes may be made, without departing from the spirit or scope of the subject matter presented herein. It will be readily understood that the aspects of the present disclosure, as generally described herein, and illustrated in the Figures, can be arranged, substituted, combined, separated, and designed in a wide variety of different configurations, all of which are explicitly contemplated herein.

This disclosure is generally drawn, inter alia, to methods, apparatuses, systems, devices, and computer program products related to an obfuscated message data generating scheme. Technologies are generally described for a method for generating dummy messages and combining the generated dummy messages with original message data so as to generate obfuscated message data. So, it is possible to intentionally manipulate and/or control co-occurrence probabilities of element combinations in the obfuscated message data, and to reduce an accuracy of data mining algorithm or technologies applied to the obfuscated message data.

In some examples, a server may be configured to calculate co-occurrence probabilities of multiple element combinations. Each of the multiple element combinations may include at least two elements that may be included in original message data. As non-limiting example, the original message data may include SNS messages or content that a user has posted on his/her SNS page. Non-limiting examples of the element may include at least one of one or more words in a message, time information in which the message is

generated, or location information at which the message is generated. Co-occurrence probability of an element combination may refer to a probability that one element in the element combination and the other element in the element combination are to be included together in a message.

Further, the server may be configured to extract, from the original message data, a first data set that may include at least one element combination having a first co-occurrence probability from among the multiple element combinations. Further, the server may be configured to extract, from the original message data, a second data set that may include at least one element combination having a second co-occurrence probability from among the multiple element combinations. For example, but not as a limitation, the first co-occurrence probability may be ranked in from top 10 percent to top 20 percent of total co-occurrence probabilities of the multiple element combinations. Further, the second co-occurrence probability may be ranked in from top 40 percent to top 60 percent of the total co-occurrence probabilities of the multiple element combinations.

Further, the server may be configured to generate dummy data by using the extracted first data set and second data set. In some embodiments, the server may be configured to generate at least one first dummy element combination that may include the element included in the at least one element combination included in the first data set. The first dummy combination is not included in the first data set. Further, the server may be configured to generate at least one second dummy element combination that may include the same elements included in the at least one element combination included in the second data set.

Further, the server may be configured to generate dummy messages that may include the first dummy element combination and the second dummy element combination. Then, the server may be configured to add the generated dummy messages to the original message data, and to generate the obfuscated message data. In this regard, the server may be configured to reduce the first co-occurrence probability of the first data set by adding the first dummy element combination, and to increase the second co-occurrence probability of the second data set by adding the second dummy element combination. Thus, the server may be configured to reduce an accuracy of data mining technologies that are applied to the obfuscated message data and use co-occurrence probabilities of combinations in the original message data. Accordingly, it is possible to protect private data of user, such as residence, gender, age, religion, ethnic group, political orientation, etc, and to prohibit estimation of the private data from the original message data, such as the SNS messages.

FIG. **1** schematically shows an illustrative example of an environment **10** including a server **120** and an end device **130**, arranged in accordance with at least some embodiments described herein. As illustrated in FIG. **1**, server **120** and end device **130** may be communicatively connected to each other via a network **110**.

Network **110** may include, as non-limiting examples, wireless networks such as a mobile radio communication network, including at least one of a 3rd generation (3G) mobile telecommunications network, a 4th or 5th generation mobile telecommunications network, various other mobile telecommunications networks, a satellite network, WiBro (Wireless Broadband Internet), Mobile WiMAX, HSDPA (High Speed Downlink Packet Access), Bluetooth, or the like.

As non-limiting examples, server **120** may refer to one or more apparatuses or servers hosted and/or supported by a service providing organization or entity that provides social networking services to multiple end devices including end device **130**.

Server **120** may be configured to calculate co-occurrence probabilities of multiple element combinations. Each of the multiple element combinations may include at least two elements that may be included in original message data. As non-limiting example, the original message data may include SNS messages or content that a user has posted on his/her SNS page. Further, non-limiting examples of the element may include at least one of one or more words in a message, time information in which the message is generated, or location information, such as GPS coordinates, at which the message is generated. Co-occurrence probability of an element combination, for example, may refer to a probability that one element in the element combination and the other element in the element combination are included or exist together in a message.

In some embodiments, server **120** may be configured to calculate a co-occurrence probability associated with one element "A" and another element "B" by using the below formula 1. The co-occurrence probability associated with one element "A" and another element "B" may be calculated as the ratio of the element "A" to other elements that exist together with the element "B" in the original message data. In the formula 1, p(A, B) may refer to the co-occurrence probability associated with the element "A" and element "B". Further, freq(A, B) may refer to a frequency of co-occurrence of the element "A" and element "B". Further, C(B) may refer to a set or group of other elements that occur or exist together with the element "B".

$$p(A, B) = \frac{freq(A, B)}{\sum_{\forall x \in C(B)} freq(x, B)} \quad \text{[formula 1]}$$

Further, server **120** may be configured to extract, from the original message data, a first data set that may include at least one element combination having a first co-occurrence probability from among the multiple element combinations. Further, server **120** may be configured to extract, from the original message data, a second data set that may include at least one element combination having a second co-occurrence probability from among the multiple element combinations. For example, but not as a limitation, the first co-occurrence probability may be ranked in from top 10 percent to top 20 percent of total co-occurrence probabilities of the multiple element combinations. That is, the first data set may include relatively significant or important information or knowledge, since the element combinations included in the first data set frequently exist or appear in the original message data. Further, the second co-occurrence probability may be ranked in from top 40 percent to top 60 percent of the total co-occurrence probabilities of the multiple element combinations. That is, the second data set does not include significant information, since the element combinations included in the second data set exist or appear in the original message data with relatively less frequency.

Server **120** may be further configured to store the extracted first data set and second data set in a database.

Further, server **120** may be configured to generate dummy data by using the first data set and the second data set. In some embodiments, server **120** may be configured to generate first dummy data to reduce the first co-occurrence probability of the first data set by using the at least one element combination included in the first data set. Specifi-

cally, server **120** may be configured to select, from the original message data, at least one first dummy element combination. The first dummy element combination may include one of the at least two elements included in the at least one element combination in the first data set. Further, the first dummy element combination is not included in the first data set. For example, but not as a limitation, in case that the first data set includes an element combination that includes an element "A" and an element "B", server **120** may be configured to select a first dummy element combination that includes the element "A" and an element "C".

Further, server **120** may be configured to generate second dummy data to increase the second co-occurrence probability of the second data set by using the at least one element combination included in the second data set. Specifically, server **120** may be configured to select, from the original message data, at least one second dummy element combination. The second dummy element combination may include an element combination from among the at least one element combination included in the second data set. Thus, the second dummy element combination may include the same elements that are included in the at least one element combination included in the second data set. For example, but not as a limitation, in case that the second data set includes an element combination that includes an element "D" and an element "E", server **120** may be configured to select a second dummy element combination that includes the element "D" and the element "E".

Further, server **120** may be configured to add the generated dummy data to the original message data so as to generate obfuscated message data. The dummy data may include a dummy message. In some embodiments, server **120** may be configured to generate a first dummy message that may include the elements included in the first dummy element combination. As the above example, server **120** may be configured to generate a first dummy message that includes the element "A" and the element "C". Server **120** may be configured to generate the first dummy message by using a text generating template. For example, the text generating template in which place holders for elements to be inserted may be predefined, such as "I went to (element) at (element)". Further, server **120** may be configured to insert the element "A" and the element "C" into the text generating template to generate the first dummy message.

Further, server **120** may be configured to generate a second dummy message that may include the elements included in the second dummy element combination. As the above example, server **120** may be configured to generate a second dummy message that includes the element "D" and the element "E". Server **120** may be configured to generate the second dummy message by inserting the element "D" and the element "E" into the text generating template.

Further, server **120** may be configured to add at least one of the first dummy message or the second dummy message into the original message data, so that the obfuscated message data may be generated. Server **120** may be further configured to store the generated obfuscated message data. The obfuscated message data may also include SNS messages or content.

Further, server **120** may be configured to render the obfuscated message data to end device **130**. In some embodiments, server **120** may be configured to render the obfuscated message data to a web browser that is installed on end device **130**. Further, server **120** may be configured to generate a program file that may be configured to make the first dummy message and the second dummy message in the obfuscated message data that is rendered on the web browser invisible. Further, server **120** may be configured to transmit, to end device **130**, the program file, along with the obfuscated message data. For example, but not as a limitation, the program file may be implemented in JavaScript. Further, server **120** may be configured to transfer and/or render, to end device **130**, SNS messages (i.e., the obfuscated message data) in a JavaScript Object Notation (JSON) format or an Extensible Mark-up Language (XML) format via JSON or web socket protocol. The JavaScript program file may be configured to designate positions of the first dummy message and the second dummy message in a Document Object Model (DOM) that is used to display the first dummy message and the second dummy message on the web browser. Further the JavaScript program file may be configured to remove the DOM elements that correspond to the first dummy message and the second dummy message from a DOM tree. So, the JavaScript program file may be configured to make the first dummy message and the second dummy message invisible on the web browser.

End device **130** may be configured to receive, from server **120**, the obfuscated message data that includes the original message data and the dummy data (e.g., the first dummy message and the second dummy message). Further, end device **130** may be configured to receive, from server **120**, the program file that may be configured to make the dummy data invisible from the obfuscated message rendered on the web browser. The program file may be executed on end device **130**, so, end device **130** may be configured to display only the original message data on a display that may be part of, or communicatively coupled to, end device **130**. Thus, it is possible to prevent only applications of data mining to the original message data without decreasing the reliability and/or readability of the original message data, such as SNS messages, as viewed by a user of end device **130**.

End device **130** may include, for example, but not as a limitation, a notebook computer, a personal computer, a smart phone, a digital camera, a tablet computer, a phablet device, or a personal communication terminal, such as PCS (Personal Communication System), GSM (Global System for Mobile communications), PDC (Personal Digital Cellular), PDA (Personal Digital Assistant), IMT (International Mobile Telecommunication)-2000, CDMA (Code Division Multiple Access)-2000, W-CDMA (W-Code Division Multiple Access) and WiBro (Wireless Broadband Internet) terminal.

FIG. **2** shows a schematic block diagram illustrating an example architecture for a server, arranged in accordance with at least some embodiments described herein. As depicted in FIG. **2**, server **120** may include a first database **210**, a calculator **220**, a data extractor **230**, a dummy data generator **240**, an obfuscated data generator **250**, a dummy filter manager **260**, a transmitter **270**, and a second database **280**. Although illustrated as discrete components, various components may be divided into additional components, combined into fewer components, or eliminated altogether while being contemplated within the scope of the disclosed subject matter. It will be understood by those skilled in the art that each function and/or operation of the components may be implemented, individually and/or collectively, by a wide range of hardware, software, firmware, or virtually any combination thereof. In that regard, one or more of first database **210**, calculator **220**, data extractor **230**, dummy data generator **240**, obfuscated data generator **250**, dummy filter manager **260**, transmitter **270**, second database **280** may be included in an instance of an application hosted on server **120**.

First database **210** may be configured to store original message data. As non-limiting examples, the original message data may include SNS messages or content that a user has posted on his/her SNS page. The original message data may include multiple elements. Non-limiting examples of the elements may include at least one of one or more words in a message, time information in which the message is generated, or location information, such as GPS coordinates, at which the message is generated.

Calculator **220** may be configured to calculate co-occurrence probabilities of multiple element combinations. Each of the multiple element combinations may include at least two elements from among the multiple elements included in the original message data. Co-occurrence probability of an element combination, for example, may refer to a probability that one element in the element combination and the other element in the element combination are included or exist together in a message.

Data extractor **230** may be configured to extract, from the original message data, a first data set that may include at least one element combination having a first co-occurrence probability from among the multiple element combinations. Further, data extractor **230** may be configured to extract, from the original message data, a second data set that may include at least one element combination having a second co-occurrence probability from among the multiple element combinations. For example, but not as a limitation, the first co-occurrence probability may be ranked in from top 10 percent to top 20 percent of total co-occurrence probabilities of the multiple element combinations. Further, the second co-occurrence probability may be ranked in from top 40 percent to top 60 percent of the total co-occurrence probabilities of the multiple element combinations.

Dummy data generator **240** may be configured to generate dummy data by using the first data set and the second data set. In some embodiments, dummy data generator **240** may be configured to generate first dummy data to reduce the first co-occurrence probability of the first data set based on the at least one element combination included in the first data set. Specifically, dummy data generator **240** may be configured to select, from the original message data, at least one first dummy element combination. The first dummy element combination may include one of the at least two elements included in the at least one element combination in the first data set. Further, the first dummy element combination is not included in the first data set. For example, but not as a limitation, in case that the first data set includes an element combination that includes an element "A" and an element "B", dummy data generator **240** may be configured to select a first dummy element combination that includes the element "A" and an element "C".

Further, dummy data generator **240** may be configured to generate second dummy data to increase the second co-occurrence probability of the second data set by using the at least one element combination included in the second data set. Specifically, dummy data generator **240** may be configured to select, from the original message data or the second data set, at least one second dummy element combination. The second dummy element combination may be an element combination from among the at least one element combination included in the second data set. Thus, the second dummy element combination may include the same elements that are included in the at least one element combination included in the second data set. For example, but not as a limitation, in case that the second data set includes an element combination that includes the element "B" and an element "E", dummy data generator **240** may be configured to select a second dummy element combination that includes the element "B" and the element "E". The element "B" is included in the element combination in the first data set. But the element "E" is not included in the element combination in the first data set, and included only in the element combination in the second data set.

Further, dummy data generator **240** may be configured to generate a first dummy message that may include the elements included in the first dummy element combination. As the above example, dummy data generator **240** may be configured to generate a first dummy message that includes the element "A" and the element "C". Dummy data generator **240** may be configured to generate the first dummy message by using a text generating template. For example, the text generating template in which place holders for elements to be inserted may be predefined, such as "I went to (element) at (element)". Further, dummy data generator **240** may be configured to insert the element "A" and the element "C" into the text generating template to generate the first dummy message.

Further, dummy data generator **240** may be configured to generate a second dummy message that may include the elements included in the second dummy element combination. As the above example, dummy data generator **240** may be configured to generate a second dummy message that includes the element "B" and the element "E". Dummy data generator **240** may be configured to generate the second dummy message by inserting the element "B" and the element "E" into the text generating template.

Obfuscated data generator **250** may be configured to add the generated dummy data to the original message data so as to generate obfuscated message data. The obfuscated message data may include SNS messages or content. Further, the dummy data may include the first dummy data including the first dummy message and the second dummy data including the second dummy message. Obfuscated data generator **250** may be configured to add at least one of the first dummy message or the second dummy message into the original message data.

Dummy filter manager **260** may be configured to generate a program file that may be configured to make the dummy data (i.e., the first dummy message and the second dummy message) in the obfuscated message data invisible. For example, but not as a limitation, the program file may be implemented in JavaScript.

Transmitter **270** may be configured to render the obfuscated message data to end device **130**. In some embodiments, transmitter **270** may be configured to render the obfuscated message data to a web browser that is installed on end device **130**. Further, transmitter **270** may be configured to transmit, to end device **130**, the program file, along with the obfuscated message data.

Second database **280** may be configured to store the first data set and the second data set.

FIG. **3** schematically shows illustrative example original message data combinations and obfuscated message data combinations, arranged in accordance with at least some embodiments described herein. As depicted in FIG. **3**, original message data combinations **310** may include multiple element combinations. For example, original message data combinations **310** may include a first element combination **311** that includes an element "A" and an element "B". Further, first element combination **311** has a co-occurrence probability of thirty percent, which may be ranked in from top 10 percent to top 20 percent of total co-occurrence probabilities of the multiple element combinations. Further, original message data combinations **310** may include a

second element combination **312** that includes the element "A" and an element "C". Further, second element combination **312** has a co-occurrence probability of thirty percent, which may be ranked in from top 10 percent to top 20 percent of total co-occurrence probabilities of the multiple element combinations. Further, original message data combinations **310** may include a third element combination **313** that includes the element "C" and the element "B". Further, third element combination **313** has a co-occurrence probability of fifteen percent, which may be ranked in from top 40 percent to top 60 percent of total co-occurrence probabilities of the multiple element combinations. Further, original message data combinations **310** may include a fourth element combination **314** that includes the element "C" and an element "D". Further, fourth element combination **314** has a co-occurrence probability of fifteen percent, which may be ranked in from top 40 percent to top 60 percent of total co-occurrence probabilities of the multiple element combinations.

Server **120** may be configured to extract a first data set **320** that may include first element combination **311** and second element combination **312** having the co-occurrence probability ranked in from top 10 percent to top 20 percent of total co-occurrence probabilities of the multiple element combinations. Further, server **120** may be configured to extract a second data set **330** that may include third element combination **313** and fourth element combination **314** having the co-occurrence probability ranked in from top 40 percent to top 60 percent of total co-occurrence probabilities of the multiple element combinations.

Further, server **120** may be configured to generate and/or select at least one first dummy element combination to reduce the co-occurrence probability of first data set **320**. The first dummy element combination may include one of the two elements included in first element combination **311** or second element combination **312** included in first data set **320**. Further, the first dummy element combination is not included in first data set **320**. For example, server **120** may be configured to select a first dummy element combination **315** that includes the element "A" and the element "D". The number of first dummy element combination to be generated and/or selected by server **120** may be changed.

Further, server **120** may be configured to generate and/or select at least one second dummy element combination to increase the co-occurrence probability of second data set **330**. The second dummy element combination may be the same element combination included in second data set **330**. Thus, the second dummy element combination may include the same elements that are included in third element combination **313** and/or fourth element combination **314** in second data set **330**. For example, but not as a limitation, server **120** may be configured to select a second dummy element combination **316** that includes the element "C" and the element "B" and a third dummy element combination **317** that includes the element "C" and the element "D". The number of second dummy element combination to be generated and/or selected by server **120** may be changed.

Further, server **120** may be configured to add first dummy element combination **315**, second dummy element combination **316**, and third dummy element combination **317** to original message data combinations **310**, so obfuscated message data combinations **340** may be generated. By adding first dummy element combination **315** including the element "A" and the element "D" and second dummy element combination **316** including the element "C" and the element "B", the co-occurrence probability of first element combination **311** including the element "A" and the element "B" may be reduced from thirty percent to ten percent. Further, by adding first dummy element combination **315** including the element "A" and the element "D", second dummy element combination **316** including the element "C" and the element "B", and third dummy element combination **317** including the element "C" and the element "D", the co-occurrence probability of second element combination **312** including the element "A" and the element "C" may be reduced from thirty percent to ten percent. Further, by adding second dummy element combination **316** including the element "C" and the element "B", the co-occurrence probability of third element combination **313** including the element "C" and the element "B" may be increased from fifteen percent to twenty percent. Further, by adding third dummy element combination **317** including the element "C" and the element "D", the co-occurrence probability of fourth element combination **314** including the element "C" and the element "D" may be increased from fifteen percent to twenty percent.

Accordingly, the co-occurrence probability of first data set **320** that may include relatively significant or important information or knowledge may be reduced. Further, the co-occurrence probability of second data set **330** that may not include significant or important information or knowledge may be increased. Thus, an accuracy of data mining algorithm or technologies applied to obfuscated message data may be reduced.

FIG. **4** schematically shows an example flow diagram of a process of a server **120** for generating obfuscated message data, arranged in accordance with at least some embodiments described herein. The process in FIG. **4** may be implemented in environment **10** including server **120** and end device **130**, as illustrated in FIG. **1**. An example process may include one or more operations, actions, or functions as illustrated by one or more blocks **410**, **420**, **430**, **440**, **450** and/or **460**. Although illustrated as discrete blocks, various blocks may be divided into additional blocks, combined into fewer blocks, or eliminated, depending on the desired implementation. Processing may begin at block **410**.

At block **410** (Calculate Co-Occurrence Probability), server **120** may calculate co-occurrence probabilities of multiple element combinations. Each of the multiple element combinations may include at least two elements that may be included in original message data. As non-limiting example, the original message data may include SNS messages or content that a user has posted on his/her SNS page. Further, non-limiting examples of the element may include at least one of one or more words in a message, time information in which the message is generated, or location information, such as GPS coordinates, at which the message is generated. Processing may proceed from block **410** to block **420**.

At block **420** (Extract First Data Set and Second Data Set), server **120** may extract, from the original message data, a first data set that may include at least one element combination having a first co-occurrence probability from among the multiple element combinations. Further, at block **420**, server **120** may extract, from the original message data, a second data set that may include at least one element combination having a second co-occurrence probability from among the multiple element combinations. For example, but not as a limitation, the first co-occurrence probability may be ranked in from top 10 percent to top 20 percent of total co-occurrence probabilities of the multiple element combinations. Further, the second co-occurrence probability may be ranked in from top 40 percent to top 60 percent of the total co-occurrence probabilities of the mul-

tiple element combinations. Further, server **120** may store the extracted first data set and second data set in a database. Processing may proceed from block **420** to block **430**.

At block **430** (Generate Dummy Data), server **120** may generate dummy data by using the first data set and the second data set. Specifically, server **120** may generate first dummy data to reduce the first co-occurrence probability of the first data set based on the at least one element combination included in the first data set. Specifically, server **120** may select, from the original message data, at least one first dummy element combination. The first dummy element combination may include one of the at least two elements included in the at least one element combination in the first data set. Further, the first dummy element combination is not included in the first data set. For example, but not as a limitation, in case that the first data set includes an element combination that includes an element "A" and an element "B", server **120** may select a first dummy element combination that includes the element "A" and an element "C".

Further, server **120** may generate second dummy data to increase the second co-occurrence probability of the second data set by using the at least one element combination included in the second data set. Specifically, server **120** may select, from the original message data, at least one second dummy element combination. The second dummy element combination may be the same an element combination from among the at least one element combination included in the second data set. Thus, the second dummy element combination may include the same elements that are included in the at least one element combination included in the second data set. For example, but not as a limitation, in case that the second data set includes an element combination that includes an element "D" and an element "E", server **120** may select a second dummy element combination that includes the element "D" and the element "E". Processing may proceed from block **430** to block **440**.

At block **440** (Generate Dummy Message), server **120** may generate dummy messages based on the dummy data generated at block **430**. Server **120** may generate a first dummy message that may include the elements included in the first dummy element combination. As the above example, server **120** may generate a first dummy message that includes the element "A" and the element "C". Server **120** may generate the first dummy message by inserting the elements (e.g., "A" and "C") into a text generating template.

Further, server **120** may generate a second dummy message that may include the elements included in the second dummy element combination. As the above example, server **120** may generate a second dummy message that includes the element "D" and the element "E". Server **120** may be configured to generate the second dummy message by inserting the element "D" and the element "E" into the text generating template. Processing may proceed from block **440** to block **450**.

At block **450** (Add Dummy Message to Original Message Data), server **120** may add at least one of the first dummy message or the second dummy message into the original message data so as to generate obfuscated message data. Server **120** may store the generated obfuscated message data. The obfuscated message data may also include SNS messages or content. Processing may proceed from block **450** to block **460**.

At block **460** (Render Obfuscated Message Data), server **120** may render the obfuscated message data generated at block **450** to end device **130**. In some embodiments, server **120** may render the obfuscated message data to a web browser that is installed on end device **130**. Further, in some embodiments, server **120** may generate a program file that may be configured to make the first dummy message and the second dummy message in the obfuscated message data invisible on the web browser. Further, server **120** may transmit, to end device **130**, the program file, along with the obfuscated message data. For example, but not as a limitation, the program file may be implemented in JavaScript.

Then, end device **130** may receive, from server **120**, the obfuscated message data that includes the original message data and the dummy data. Further, end device **130** may receive the program file that may be configured to make the dummy data invisible from the obfuscated message rendered on the web browser. The program file may be executed on end device **130**, so, end device **130** may display only the original message data on a display that may be part of, or communicatively coupled to, end device **130**. Thus, it is possible to prevent only applications of data mining to the original message data without decreasing the reliability and readability of the original message data.

One skilled in the art will appreciate that, for this and other processes and methods disclosed herein, the functions performed in the processes and methods may be implemented in differing order. Furthermore, the outlined steps and operations are only provided as examples, and some of the steps and operations may be optional, combined into fewer steps and operations, or expanded into additional steps and operations without detracting from the essence of the disclosed embodiments.

FIG. **5** illustrates a computer program product that may be utilized to provide an obfuscated message data generating scheme, arranged in accordance with at least some embodiments described herein. Computer program product **500** may include a signal bearing medium **510**. Signal bearing medium **510** may include one or more instructions **520** that, when executed by, for example, a processor, may provide the functionality described above with respect to FIGS. **1-4**. By way of example, instructions **520** may include: one or more instructions for calculating co-occurrence probabilities of a plurality of combinations, each of which includes at least two elements that are included in original message data; one or more instructions for extracting, from the original message data, a first data set that includes at least one combination that has a first co-occurrence probability from among the plurality of combinations and a second data set that includes at least one combination that has a second co-occurrence probability from among the plurality of combinations; one or more instructions for generating dummy data by using the first data set and the second data set; or one or more instructions for adding the generated dummy data to the original message data to generate obfuscated message data. Thus, for example, referring to FIG. **2**, server **120** may undertake one or more of the blocks shown in FIG. **4** in response to instructions **520**.

In some implementations, signal bearing medium **510** may encompass a computer-readable medium **530**, such as, but not limited to, a hard disk drive, a CD, a DVD, a digital tape, memory, etc. In some implementations, signal bearing medium **510** may encompass a recordable medium **540**, such as, but not limited to, memory, read/write (R/W) CDs, R/W DVDs, etc. In some implementations, signal bearing medium **510** may encompass a communications medium **550**, such as, but not limited to, a digital and/or an analog communication medium (e.g., a fiber optic cable, a waveguide, a wired communications link, a wireless communication link, etc.). Thus, for example, computer program product **500** may be conveyed to one or more modules of server **120** by an RF signal bearing medium **510**, where the

signal bearing medium **510** is conveyed by a wireless communications medium **550** (e.g., a wireless communications medium conforming with the IEEE 802.11 standard).

FIG. **6** is a block diagram illustrating an example computing device that may be utilized to provide an obfuscated message data generating scheme, arranged in accordance with at least some embodiments described herein. In these examples, elements of computing device **600** may be arranged or configured for a device. In a very basic configuration **602**, computing device **600** typically includes one or more processors **604** and a system memory **606**. A memory bus **608** may be used for communicating between processor **604** and system memory **606**.

Depending on the desired configuration, processor **604** may be of any type including but not limited to a microprocessor (μP), a microcontroller (μC), a digital signal processor (DSP), or any combination thereof. Processor **604** may include one more levels of caching, such as a level one cache **610** and a level two cache **612**, a processor core **614**, and registers **616**. An example processor core **614** may include an arithmetic logic unit (ALU), a floating point unit (FPU), a digital signal processing core (DSP Core), or any combination thereof. An example memory controller **618** may also be used with processor **604**, or in some implementations memory controller **618** may be an internal part of processor **604**.

Depending on the desired configuration, system memory **606** may be of any type including but not limited to volatile memory (such as RAM), nonvolatile memory (such as ROM, flash memory, etc.) or any combination thereof. System memory **606** may include an operating system **620**, an application **622**, and program data **624**. Application **622** may include instructions **626** that may be arranged to perform the functions as described herein including the actions described with respect to server **120** architecture as shown in FIG. **2** or including the actions described with respect to the flow charts shown in FIG. **4**. In some examples, application **622** may be arranged to operate with program data **624** on an operating system **620** such that the schemes for generating obfuscated message data.

Computing device **600** may have additional features or functionality, and additional interfaces to facilitate communications between basic configuration **602** and any required devices and interfaces. For example, a bus/interface controller **630** may be used to facilitate communications between basic configuration **602** and one or more data storage devices **632** via a storage interface bus **634**. Data storage devices **632** may be removable storage devices **636**, non-removable storage devices **638**, or a combination thereof. Examples of removable storage and non-removable storage devices include magnetic disk devices such as flexible disk drives and hard-disk drives (HDD), optical disk drives such as compact disk (CD) drives or digital versatile disk (DVD) drives, solid state drives (SSD), and tape drives to name a few. Example computer storage media may include volatile and nonvolatile, removable and non-removable media implemented in any method or technology for storage of information, such as computer readable instructions, data structures, program modules, or other data.

System memory **606**, removable storage devices **636** and non-removable storage devices **638** are examples of computer storage media. Computer storage media includes, but is not limited to, RAM, ROM, EEPROM, flash memory or other memory technology, CD-ROM, digital versatile disks (DVD) or other optical storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices, or any other medium which may be used to store the desired information and which may be accessed by computing device **600**. Any such computer storage media may be part of computing device **600**.

Computing device **600** may also include an interface bus **640** for facilitating communication from various interface devices (e.g., output devices **642**, peripheral interfaces **644**, and communication devices **646**) to basic configuration **602** via bus/interface controller **630**. Example output devices **642** include a graphics processing unit **648** and an audio processing unit **650**, which may be configured to communicate to various external devices such as a display or speakers via one or more A/V ports **652**. Example peripheral interfaces **644** include a serial interface controller **654** or a parallel interface controller **656**, which may be configured to communicate with external devices such as input devices (e.g., keyboard, mouse, pen, voice input device, touch input device, etc.) or other peripheral devices (e.g., printer, scanner, etc.) via one or more I/O ports **658**. An example communication device **646** includes a network controller **660**, which may be arranged to facilitate communications with one or more other computing devices **662** over a network communication link via one or more communication ports **664**.

The network communication link may be one example of a communication media. Communication media may typically be embodied by computer readable instructions, data structures, program modules, or other data in a modulated data signal, such as a carrier wave or other transport mechanism, and may include any information delivery media. A "modulated data signal" may be a signal that has one or more of its characteristics set or changed in such a manner as to encode information in the signal. By way of example, and not limitation, communication media may include wired media such as a wired network or direct-wired connection, and wireless media such as acoustic, radio frequency (RF), microwave, infrared (IR) and other wireless media. The term computer readable media as used herein may include both storage media and communication media.

Computing device **600** may be implemented as a portion of a small-form factor portable (or mobile) electronic device such as a cell phone, a personal data assistant (PDA), a personal media player device, a wireless web-watch device, a personal headset device, an application specific device, or a hybrid device that include any of the above functions. Computing device **600** may also be implemented as a personal computer including both laptop computer and non-laptop computer configurations.

The present disclosure is not to be limited in terms of the particular embodiments described in this application, which are intended as illustrations of various aspects. Many modifications and variations can be made without departing from its spirit and scope, as will be apparent to those skilled in the art. Functionally equivalent methods and apparatuses within the scope of the disclosure, in addition to those enumerated herein, will be apparent to those skilled in the art from the foregoing descriptions. Such modifications and variations are intended to fall within the scope of the appended claims. The present disclosure is to be limited only by the terms of the appended claims, along with the full scope of equivalents to which such claims are entitled. It is to be understood that this disclosure is not limited to particular methods, reagents, compounds, compositions or biological systems, which can, of course, vary. It is also to be understood that the terminology used herein is for the purpose of describing particular embodiments only, and is not intended to be limiting.

With respect to the use of substantially any plural and/or singular terms herein, those having skill in the art can translate from the plural to the singular and/or from the singular to the plural as is appropriate to the context and/or application. The various singular/plural permutations may be expressly set forth herein for sake of clarity.

It will be understood by those within the art that, in general, terms used herein, and especially in the appended

claims (e.g., bodies of the appended claims) are generally intended as "open" terms (e.g., the term "including" should be interpreted as "including but not limited to," the term "having" should be interpreted as "having at least," the term "includes" should be interpreted as "includes but is not limited to," etc.). It will be further understood by those within the art that if a specific number of an introduced claim recitation is intended, such an intent will be explicitly recited in the claim, and in the absence of such recitation no such intent is present. For example, as an aid to understanding, the following appended claims may contain usage of the introductory phrases "at least one" and "one or more" to introduce claim recitations. However, the use of such phrases should not be construed to imply that the introduction of a claim recitation by the indefinite articles "a" or "an" limits any particular claim containing such introduced claim recitation to embodiments containing only one such recitation, even when the same claim includes the introductory phrases "one or more" or "at least one" and indefinite articles such as "a" or "an" (e.g., "a" and/or "an" should be interpreted to mean "at least one" or "one or more"); the same holds true for the use of definite articles used to introduce claim recitations. In addition, even if a specific number of an introduced claim recitation is explicitly recited, those skilled in the art will recognize that such recitation should be interpreted to mean at least the recited number (e.g., the bare recitation of "two recitations," without other modifiers, means at least two recitations, or two or more recitations). Furthermore, in those instances where a convention analogous to "at least one of A, B, and C, etc." is used, in general such a construction is intended in the sense one having skill in the art would understand the convention (e.g., "a system having at least one of A, B, and C" would include but not be limited to systems that have A alone, B alone, C alone, A and B together, A and C together, B and C together, and/or A, B, and C together, etc.). In those instances where a convention analogous to "at least one of A, B, or C, etc." is used, in general such a construction is intended in the sense one having skill in the art would understand the convention (e.g., "a system having at least one of A, B, or C" would include but not be limited to systems that have A alone, B alone, C alone, A and B together, A and C together, B and C together, and/or A, B, and C together, etc.). It will be further understood by those within the art that virtually any disjunctive word and/or phrase presenting two or more alternative terms, whether in the description, claims, or drawings, should be understood to contemplate the possibilities of including one of the terms, either of the terms, or both terms. For example, the phrase "A or B" will be understood to include the possibilities of "A" or "B" or "A and B."

In addition, where features or aspects of the disclosure are described in terms of Markush groups, those skilled in the art will recognize that the disclosure is also thereby described in terms of any individual member or subgroup of members of the Markush group.

As will be understood by one skilled in the art, for any and all purposes, such as in terms of providing a written description, all ranges disclosed herein also encompass any and all possible subranges and combinations of subranges thereof. Any listed range can be easily recognized as sufficiently describing and enabling the same range being broken down into at least equal halves, thirds, quarters, fifths, tenths, etc. As a non-limiting example, each range discussed herein can be readily broken down into a lower third, middle third and upper third, etc. As will also be understood by one skilled in the art all language such as "up to," "at least," and the like include the number recited and refer to ranges which can be subsequently broken down into subranges as discussed above. Finally, as will be understood by one skilled in the art, a range includes each individual member. Thus, for example, a group having 1-3 cells refers to groups having 1, 2, or 3 cells. Similarly, a group having 1-5 cells refers to groups having 1, 2, 3, 4, or 5 cells, and so forth.

From the foregoing, it will be appreciated that various embodiments of the present disclosure have been described herein for purposes of illustration, and that various modifications may be made without departing from the scope and spirit of the present disclosure. Accordingly, the various embodiments disclosed herein are not intended to be limiting, with the true scope and spirit being indicated by the following claims.

What is claimed is:

1. A method performed under control of a server, comprising:

calculating co-occurrence probabilities of a plurality of combinations, each of which includes at least two elements that are included in original message data;

extracting, from the original message data, a first data set that includes at least one combination that has a first co-occurrence probability from among the plurality of combinations and a second data set that includes at least one combination that has a second co-occurrence probability from among the plurality of combinations;

generating first dummy data by using the first data set and second dummy data by using the second data set, the first dummy data reduces the first co-occurrence probability of the first data set and the second dummy data increases the second co-occurrence probability of the second data set;

adding the generated first dummy data and second dummy data to the original message data to generate obfuscated message data;

rendering the obfuscated message data to a web browser that is installed on an end device; and

transmitting, to the end device, a program file that makes the first dummy data and second dummy data invisible from the obfuscated message rendered on the web browser,

wherein the first co-occurrence probability is ranked in from top 10 percent to top 20 percent of the co-occurrence probabilities, and

wherein the second co-occurrence probability is ranked in from top 40 percent to top 60 percent of the co-occurrence probabilities.

2. The method of claim **1**, wherein the generating the second dummy data includes:

a combination from among the at least one combination included in the second data set.

3. The method of claim **2**, wherein the generating of the first dummy data includes:

selecting, from the original message data, a dummy combination that includes one of the at least two elements included in the at least one combination included in the first data set, and

wherein the dummy combination is not included in the first data set.

4. The method of claim **3**, wherein the first dummy data includes a dummy message, and

wherein the generating of the first dummy data further includes:

generating the dummy message that includes at least two elements included in the dummy combination by using a text generating template.

5. The method of claim 1, wherein the at least two elements includes words in a message and at least one of time information in which the message is generated, or location information at which the message is generated.

6. A server, comprising:

a processor; and

a non-transitory memory coupled to the processor, wherein the non-transitory memory stores program instructions executable by the processor to cause the system to perform operations comprising:

calculating co-occurrence probabilities of a plurality of combinations, each of which includes at least two elements that are included in original message data;

extracting, from the original message data, a first data set that includes at least one combination that has a first co-occurrence probability from among the plurality of combinations and a second data set that includes at least one combination that has a second co-occurrence probability from among the plurality of combinations;

generating first dummy data by using the first data set and second the second data set by using the first data set, the first dummy data reduces the first co-occurrence probability of the first data set and the second dummy data increases the second co-occurrence probability of the second data set; and

adding the generated first dummy data and second dummy data to the original message data to generate obfuscated message data,

wherein the first co-occurrence probability is ranked in from top 10 percent to top 20 percent of the co-occurrence probabilities, and

wherein the second co-occurrence probability is ranked in from top 40 percent to top 60 percent of the co-occurrence probabilities.

7. The server of claim 6 wherein the operations further comprise:

rendering the obfuscated message data to a web browser that is installed on an end device.

8. The server of claim 7, wherein the operations further comprise:

generating a program file that makes the dummy data invisible from the obfuscated message rendered on the web browser, and

transmitting further transmits, to the end device, the program file.

9. The server of claim 6, wherein generating the second dummy data comprises:

generating a second dummy data that includes a combination from among the at least one combination included in the second data set.

10. The server of claim 9, wherein generating the first dummy data comprises generating the first dummy data by selecting, from the original message data, a dummy combination that includes one of the at least two elements included in the least one combination included in the first data set, and

wherein the dummy combination is not included in the first data set.

11. The server of claim 10, wherein the dummy data includes a dummy message, and

wherein generating the first dummy data comprises generating a dummy message that includes at least two elements included in the dummy combination by using a text generating template.

12. The server of claim 6, wherein the at least two elements includes one or more words in a message and at least one of time information in which the message is generated, or location information at which the message is generated.

13. The server of claim 6, further comprising:

a first database configured to store the original message data; and

a second database configured to store the first data set and the second data set.

14. A non-transitory computer-readable storage medium having stored thereon computer-executable instructions that, in response to execution, cause a server to perform operations, comprising:

calculating co-occurrence probabilities of a plurality of combinations, each of which includes at least two elements that are included in original message data;

extracting, from the original message data, a first data set that includes at least one combination that has a first co-occurrence probability from among the plurality of combinations and a second data set that includes at least one combination that has a second co-occurrence probability from among the plurality of combinations;

generating first dummy data by using the first data set and second dummy data by using the second data set, the first dummy data reduces the first co-occurrence probability of the first data set and the second dummy data increases the second co-occurrence probability of the second data set; and

adding the generated first dummy data and second dummy data to the original message data to generate obfuscated message data,

wherein the first co-occurrence probability is ranked in from top 10 percent to top 20 percent of the co-occurrence probabilities, and

wherein the second co-occurrence probability is ranked in from top 40 percent to top 60 percent of the co-occurrence probabilities.

15. The non-transitory computer-readable storage medium of claim 14, wherein the generating of the dummy data includes

generating a second dummy data that includes a combination from among the at least one combination included in the second data set.

16. The non-transitory computer-readable storage medium of claim 15, wherein the generating of the first dummy data includes:

selecting, from the original message data, a dummy combination that includes one of the at least two elements included in the least one combination included in the first data set, and

wherein the dummy combination is not included in the first data set.

17. The non-transitory computer readable storage medium of claim 16, wherein the dummy data includes a dummy message, and

wherein the generating of the first dummy data further includes generating the dummy message that includes at least two elements included in the dummy combination by using a text generating template.

18. The non-transitory computer readable storage medium of claim 14, wherein the generating the second dummy data includes a combination from among the at least one combination included in the second data set.

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UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 9,444,797 B2
APPLICATION NO. : 14/327814
DATED : September 13, 2016
INVENTOR(S) : Kurabayashi

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the Claims

In Column 16, Line 50, in Claim 2, delete "includes:" and insert -- includes --, therefor.

In Column 17, Line 21, in Claim 6, delete "second the second data" and insert -- the second data --, therefor.

In Column 17, Line 35, in Claim 7, delete "claim 6" and insert -- claim 6, --, therefor.

Signed and Sealed this
Seventh Day of March, 2017

Michelle K. Lee

Michelle K. Lee
Director of the United States Patent and Trademark Office